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Abstract

Children's Approaches to Learning (AtL) has been identified in research and policy as a key domain of children's school readiness. Nevertheless, there remains a lack of consensus around the exact definition and specific dimensions of AtL. Additionally, relatively little is known about the child and family factors that shape early AtL, how it varies in the general population, or how it develops and changes through the early years of schooling. This exploratory study examined measurement and growth of children's AtL over six occasions spanning kindergarten through second grade in the ECLS-K Class of 2010-2011. Large statistically significant correlations were observed between children's AtL and measures of self-regulation and social skills. Latent classes of AtL growth were identified through growth mixture modeling and regressed onto explanatory covariates in order to uncover patterns and sources of variation in children's AtL. Results revealed Higher and Lower AtL growth classes significantly associated with demographic and parenting variables measured in kindergarten. In particular, sex (male) and poverty were associated with Lower AtL trajectories, whereas the presence of both biological parents in the household, and parent involvement at school and at home predicted membership in the Higher AtL group. Implications of these findings for further clarification and exploration of AtL as a construct are discussed.

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APPROACHES TO LEARNING IN THE ECLS-K: MEASUREMENT AND GROWTH
FROM KINDERGARTEN TO GRADE 2

Katharine W. Buek

A DISSERTATION

in

Education

Presented to the Faculties of the University of Pennsylvania

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APPROACHES TO LEARNING IN THE ECLS-K: MEASUREMENT AND GROWTH
FROM KINDERGARTEN TO GRADE 2

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Katharine Whittington Buek

DEDICATION

To Jesus Christ, the Author and Finisher of my faith.

All glory, honor and praise to Him now and forever.

Amen.

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This work represents much more than the past six months of literature review, data analyses, writing, and editing. This dissertation is the capstone of four of the most intellectually, emotionally, and spiritually productive years of my life. These years have brought me through some of the most poignant challenges and greater personal growth than I've experienced thus far in my adult life. Many people have been there with me and helped me through various phases of this life-changing experience.

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ABSTRACT

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Paul A. McDermott

Children's Approaches to Learning (AtL) has been identified in research and policy as a key domain of children's school readiness. Nevertheless, there remains a lack of consensus around the exact definition and specific dimensions of AtL. Additionally, relatively little is known about the child and family factors that shape early AtL, how it varies in the general population, or how it develops and changes through the early years of schooling. This exploratory study examined measurement and growth of children's AtL over six occasions spanning kindergarten through second grade in the ECLS-K Class of 2010-2011. Large statistically significant correlations were observed between children's AtL and measures of self-regulation and social skills. Latent classes of AtL growth were identified through growth mixture modeling and regressed onto explanatory covariates in order to uncover patterns and sources of variation in children's AtL. Results revealed Higher and Lower AtL growth classes significantly associated with demographic and parenting variables measured in kindergarten. In particular, sex (male) and poverty were associated with Lower AtL trajectories, whereas the presence of both biological parents in the household, and parent involvement at school and at home predicted membership in the Higher AtL group. Implications of these findings for further clarification and exploration of AtL as a construct are discussed.

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CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

Approaches to Learning in the Context of Early Childhood Development

Theoretical and Conceptual Basis

Current theory emphasizes the transactional nature of child development (Sameroff, 2009). Children both exert influence upon and are influenced by the people around them, as well as the social and cultural milieu in which they are developing. This theoretical approach affirms the paramount importance of family and classroom contexts for children's development, while at the same time recognizing that children's actions and responses are themselves powerful drivers of development. Research examining the relationships between child, parent, and classroom factors in predicting children's educational outcomes lends support to this theoretical premise.

Substantial literatures, for instance, document the reciprocal effects of parenting and home environments for children's social-emotional development and academic achievement (Chazan-Cohen et al., 2009; Grolnick & Ryan, 1989; Honig, 1982). In turn, children's temperament, social and emotional skills, and behavior have been shown to significantly predict classroom adjustment and, both directly and indirectly, children's learning and development (Baker, Grant, & Morlock, 2008; Bandura, Barbaranelli, Caprara, & Pastorelli, 1996; Buyse, Verschueren, Doumen, Van Damme, & Maes, 2008; Hamre & Pianta, 2001; Skinner & Belmont, 1993).

Drawing upon transactional theories of development and the empirical evidence of the relationship between children's classroom behavior and learning outcomes, experts have postulated the concept of children's Approaches to Learning (AtL; Hyson, 2008;

Kagan, Moore, & Bredekamp, 1995) – alternatively known as learning behaviors (McDermott et al., 2009; Stott, McDermott, Green, & Francis, 1988), or learning-related skills (McClelland, Acock, & Morrison, 2006) – as a critical component of child development. Federal education policy defines five domains of early learning widely used at national and state levels for monitoring children’s development and evaluating educational effectiveness: (a) approaches to learning, (b) social and emotional development, (c) language and literacy; (d) cognition and general knowledge; and (d) physical well-being and motor development (Kagan et al., 1995). Brief descriptions of each domain are provided in Table 1.

Table 1: *Definitions of the Five Domains of Development and School Readiness*

Domain	Description
Approaches to learning	Predispositions or styles characterizing the ways children approach learning situations. Subdomains include emotional and behavioral self-regulation, executive functioning, initiative and curiosity, and creativity.
Social and emotional development	Children’s feeling states regarding the self and others, and interpersonal interactions with both peers and adults. Subdomains include relationships with adults, relationships with children, emotional functioning, and sense of identity and belonging.
Language and literacy	Acquisition of linguistic forms and procedures, as well as the social forms for expression and interpretation of language. Subdomains include attending and understanding, communicating and speaking, vocabulary, emergent literacy, phonological awareness, print and alphabet knowledge, comprehension and text structure, and writing.
Cognitive and general knowledge	Comprises aspects of representational thought, problem-solving, and knowledge. Subdomains include operations and algebraic thinking, measurement, geometry and spatial sense, scientific inquiry, reasoning and problem-solving.
Physical well-being and motor development	Growth, physical fitness, and body physiology. Subdomains include perception; gross and fine motor skills; and health, safety and nutrition.

Note. Descriptions based on Kagan, S.L., Moore, E., and Bredekamp, S., 1995. Subdomains are per U.S. Department of Health and Human Services, Administration of Children and Families, Office of Head Start, 2015.

AtL is conceptually quite different from the other domains in one key respect. Namely, while other domains comprise specific competencies which are, in and of themselves, considered end goals of normative development (e.g., reading and math skills, motor skills, etc.), AtL refers to a set of personal traits or predispositions that characterize the way that children go about acquiring skills across the other domains (Hyson, 2008; Kagan et al., 1995; National Research Council [NRC], 2008). In the language of transactional development theory, AtL characterizes the typical attitudes and patterns of responding that children bring to transactions with teachers, peers and tasks in the classroom context.

Definitions of AtL as a construct vary from source to source. Synthesizing across a variety of sources, including federal policy documents and the work of researchers who specialize in the domain, however, it is possible to identify and describe the conceptual foundations of AtL. AtL is essentially a set of behavioral manifestations of psychosocial processes including self-regulation, executive function, and motivation. AtL incorporates aspects of each of these concepts as they relate specifically to children's typical patterns of responding to learning tasks, generally, and in classroom contexts, specifically.

Self-regulation. Self-regulation as a concept can be broadly defined as the ability to regulate one's emotions, behavior, and attention (Hyson, 2008; McClelland & Cameron, 2012; Phillips & Shonkoff, 2000). Self-regulation involves progressive development of capacities such as frustration tolerance, delayed gratification, and impulse control, which signal a child's ability to manage intense emotions and desires for the purpose of achieving a desired goal. In the early childhood period (broadly, birth to

age eight), self-regulation involves suppression of disruptive or violent behaviors, as well as the use of appropriate coping mechanisms to manage antisocial emotional impulses like anger and aggression (Anderson & Messick, 1974). It also involves development of certain social skills, particularly with regard to understanding of social norms and appropriate behavior in social contexts. Prosocial classroom behaviors including cooperation, listening, turn-taking, following instructions, organizing materials, and other manifestations of self-control are critical for classroom adjustment and learning (McClelland & Morrison, 2003).

Self-regulation has been shown to predict important mediating factors such as teacher-student relationships, peer interactions, and classroom behavior, as well as academic achievement both concurrently and over time (Blair & Razza, 2007; Graziano, Reavis, Keane, & Calkins, 2007; Howse, Calkins, Anastopoulos, Keane, & Shelton, 2003; Ponitz, McClelland, Matthews, & Morrison, 2009; Trentacosta & Izard, 2007).

Executive function. Executive function is a subcategory of self-regulation that refers to control of cognitive (as opposed to socioemotional or behavioral) processes (Clark, Martinez, Nelson, Wiebe, & Espy, 2014). In particular, executive function comprises cognitive functions such as focusing and sustaining attention, planning and problem-solving, and cognitive flexibility (Clark et al., 2014; McClelland & Cameron, 2012; Phillips & Shonkoff, 2000). Attentional focusing is a critical requirement for learning. It allows children to direct attention to learning tasks, sustain attention long enough to comprehend and work through a task or problem, and “tune out” distractors in the environment so that they can work effectively. Cognitive flexibility refers to the

capacity to devise and test different strategies to solve problems or complete challenging tasks and to shift thinking according to the changing parameters or demands of a task (Hyson, 2008). Phillips and Shonkoff (2000) note that children's abilities to "initiate, shift, inhibit, sustain, plan, organize, and strategize" embody fundamental executive functions. Executive function, like its parent construct, has consistently demonstrated significant predictive associations with adaptive classroom and learning-related behaviors and academic performance in young children above and beyond cognitive ability (Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Hughes & Ensor, 2011; Masten et al., 2012; McClelland, Cameron, Wanless, & Murray, 2007).

Motivation. The third foundational aspect of AtL includes children's motivation to engage and persist in learning-related tasks. Both competence motivation (the inclination toward exploration and challenge-seeking) and intrinsic motivation (the drive to learn for the sake of learning, without inducement or reward), which are signaled by characteristics like curiosity, interest, enjoyment, and task persistence in learning contexts, are included under the umbrella of AtL (Hyson, 2008; Kagan et al., 1995; NRC, 2008). Motivation is a particularly crucial aspect of AtL, in that it provides the impetus for children to apply their various skills and competencies (e.g., social skills, cognitive abilities) to increasingly challenging tasks. A large body of evidence documents robust associations between student motivation and learning outcomes (Berhenke, Miller, Brown, Seifer, & Dickstein, 2011; Broussard & Garrison, 2004; Mokrova, O'Brien, Calkings, Leerkes, & Marcovitch, 2013; Viljaranta, Lerkkanen, Poikkeus, Aunola, & Nurmi, 2009).

Importance for Learning and Development

For nearly 50 years, educators, researchers, and policymakers have recognized the importance of children's characteristic learning-related attitudes and behaviors as powerful predictors of school success. DiPerna, Volpe, and Elliott (2005) found that interpersonal skills (including self-control), classroom engagement, study skills, and motivation (including initiative, persistence, and goal-directed behavior) predicted math achievement in kindergarten through sixth grade, with motivation acting as a mediator influencing study skills and engagement. In a subsequent study using data from the Early Childhood Longitudinal Survey (ECLS-K), authors found that children's AtL, social skills, and behavior together predicted growth in math achievement between kindergarten and third grade (DiPerna, Lei, & Reid, 2007).

Similarly, kindergarten AtL has been associated with growth in reading and math achievement through fifth grade (Carlson, 2013; Li-Grining, Votruba-Drzal, Maldonado-Carreño, & Haas, 2010). Others have identified significant relationships between AtL in the early grades and later outcomes such as enrollment in special education classes, grade retention, and suspensions in later elementary and middle school (Mattison, 2016), suggesting that AtL may influence children's social and behavioral outcomes as well as academic achievement. The predictive validity of AtL has proven robust across socioeconomic and cultural lines, both in the U.S. and internationally. For example, Durbrow, Schaefer, and Jimerson (2000) found that learning behaviors and children's background (e.g., home environment, parent involvement, and parent education)

predicted large amounts of variance in children's academic performance in the West Indies.

Research focusing on preschool populations suggests that not only are distinct patterns of learning behaviors evident in early childhood before a child enters kindergarten, but that they are also related to later AtL and schooling outcomes. Dominguez (2010) found that preschool learning behaviors mediated children's growth in alphabet knowledge and math skills over the course of one year of preschool. McWayne, Fantuzzo and McDermott (2004) found that preschool learning behaviors significantly predicted children's performance on the Early Screening Inventory in kindergarten, above and beyond classroom quality, neighborhood characteristics, and child demographic variables. Additionally, profile analyses showed that classroom competencies and AtL successfully distinguished high- and low-performing children (McWayne et al., 2004). Nelson et al. (2017) found that preschool executive control (e.g., working memory, inhibitory control, and flexible shifting) predicted first-grade learning engagement.

Interestingly, evidence from the ECLS-K suggests that early AtL may contribute to later outcomes in a reciprocal fashion, with positive AtL in the earliest classroom encounters contributing to early successes in learning that then reinforce positive AtL. Tach and Farkas (2006), for instance, found that AtL in kindergarten and first grade predicted children's assignment to reading groups based on ability levels, which in turn predicted higher ratings of AtL and reading achievement. Bodovski and Youn (2011) found that first-grade AtL predicted fifth-grade AtL and achievement, and that first-grade

achievement predicted AtL in fifth grade. Additionally, their findings indicated that AtL was the strongest predictor of achievement, above and beyond other measures of social and behavioral adjustment.

Particularly important from a policy perspective is evidence that AtL may act as a protective factor for children from disadvantaged backgrounds and those beginning school with lower levels of ability. For instance, Meng (2015) found that AtL moderated the effect of home literacy environment on children's receptive vocabulary development in a Head Start population. Similarly, Matthews, Kizzie, Rowley, and Cortina (2010) found that African American boys who had the highest levels of positive learning-related behaviors experienced greater growth in literacy than other boys and displayed achievement growth trajectories mirroring those of the highest achieving students, despite being from homes with low socioeconomic status (SES) and poorer literacy environments. Bodovski and Farkas (2007) noted that levels of AtL explained more than half of the variance in math achievement growth from kindergarten to third grade, even after controlling for kindergarten skill levels and instruction time. The effect of AtL was found to be strongest among the lowest performing students.

Thus far, very little research has examined change or growth in AtL over time. Three such studies have been conducted by McDermott and colleagues using longitudinally scaled measures of learning behaviors over the prekindergarten to early elementary period. McDermott and colleagues identified longitudinal patterns of growth in learning behaviors from prekindergarten to first grade associated with distal academic and behavioral outcomes in a large sample of Head Start students (McDermott, Rikoon,

& Fantuzzo, 2014, 2016; McDermott et al., in press). Trajectories characterized by higher levels of learning behaviors were associated with second-grade proficiency in reading, vocabulary, language, math, and science as well as more optimal classroom adjustment and attendance at the end of first grade.

Measurement of AtL

The measurement of psychological constructs such as self-regulation, executive function and motivation can be resource intensive, and requires a great deal of creativity, since these constructs are largely internal processes which cannot be directly observed or reported by young children. Many such measures are individually administered direct assessments that require trained assessors, often with the use of computer programs, manipulatives, or other specialized materials. Alternatively, measures of AtL, by definition, capture patterns of observable behavior in learning contexts, and as such usually take the form of teacher-completed rating scales. The teacher rates an individual student according to the frequency with which he or she displays certain behaviors in typical day-to-day classroom activities. Examples of such behaviors are displayed in Table 2.

Many measures of AtL are subscales of instruments that assess multiple dimensions of social, emotional and/or academic functioning. One of the most widely used in education research, the ECLS-K AtL scale is part of a longer measure of social skills that also appraises Self-Control, Interpersonal Skills, Internalizing Problem Behaviors, and Externalizing Problem Behaviors (Tourangeau et al., 2017). Barbu, Yaden, Levine-Donnerstein, and Marx (2015) constructed an AtL scale from items taken

from subscales of the Devereux Early Childhood Assessment (LeBuffe & Naglieri, 1999), and the NRC report on early childhood assessment (2008) identified subscales of the E-Z Personality Questionnaire (Zigler, Bennett-Gates, Hodapp, & Heinrich, 2002) and the NEPSY (Brooks, Sherman, & Strauss, 2009) as measures of learning-related motivation and executive function, respectively.

Table 2: *Illustrative Items Used in Selected Measures of Approaches to Learning*

AtL measure	Example item srelitems
Classroom Performance Profile (CPP; Crosby & French, 2002)	Works independently Adapts to new situations or changes Accepts responsibility Works cooperatively with other children Exhibits negative attention-getting behavior Begins tasks that are difficult Solves problems in unique/unusual ways
Arizona AtL scale (Barbu et al., 2015)	Sustains positive interactions with other children Adjusts behavior to correspond to different settings Shows curiosity as a learner Attends to tasks Copes with frustration Takes risks during learning situations Follows rules
Learning Behaviors Scale (LBS; McDermott, 1999)	Displays reluctance to tackle new tasks Tries but concentration soon fades Doesn't stick to tasks Easily distracted or seeks distraction Follows peculiar or inflexible procedures Doesn't work well when in bad moods Aggressive or hostile when corrected
ECLS-K AtL scale (Tourangeau et al., 2017)	Keeps belongings organized Works independently Follows class rules Pays attention well Easily adapts to changes in routine Shows eagerness to learn new things Persists in completing tasks

Note. Items shown here were selected and abbreviated for illustrative purposes and are not a complete listing of all items included in the referenced measures.

While these and other measures of AtL have been employed in research at local, state, and national levels, much work remains to ensure the reliability and validity of inferences drawn from their scores, especially when used with geographically and socially diverse groups of children. Most of the available measures of AtL were developed and tested on populations representing relatively racially and/or economically homogenous samples, are intended for use with a narrow age range, and have not been scaled for longitudinal use. The Classroom Performance Profile, for instance, was developed for a population of low-income, white, rural students in Pennsylvania in kindergarten through third grade (Crosby & French, 2002), while the Arizona AtL scale was developed and tested on a sample representative of the Arizona kindergarten population, which included large proportions of Hispanic and low-income students (Barbu, Marx, Yaden, & Levine-Donnerstein, 2016). Similarly, the Learning-to-Learn Scales were developed with a sample of predominantly African American, low-income children attending Head Start centers in Philadelphia (McDermott et al., 2011).

The Learning Behaviors Scale (McDermott, 1999) and Preschool Learning Behaviors Scale (PLBS ; McDermott, Leigh, & Perry, 2002) are by far the most rigorously developed and validated measures of AtL currently available. Both were developed and normed on nationally representative samples. Their structure, reliability, and convergent and predictive validity have been confirmed in a number of studies using different samples (Buchanan, McDermott, & Schaefer, 1998; Canivez, Willengborg, & Kearney, 2006; Fantuzzo, Perry, & McDermott, 2004; Hahn, Schaefer, Merino, & Worrell, 2009; Schaefer & McDermott, 1999; Worrell, Vandiver, & Watkins, 2001; Yen,

Konold, & McDermott, 2004). While the PLBS is intended specifically for prekindergarten populations, the LBS can be used with students from kindergarten through twelfth grade. These measures have thus far been used primarily in Head Start research, which focuses on low-income samples, typically with a high proportion of minority students.

The ECLS-K AtL scale represents a unique opportunity to examine AtL in a large, nationally representative longitudinal sample. While it was initially developed for use with kindergarten and first grade students (Berry et al., 2004), the survey employs the measure in biannual ratings of students from kindergarten through eighth grade. To date, very little psychometric information has been published for the scale. No factor analytic studies have been published to verify the existence of an AtL factor, although sources indicate that such evidence exists (Rock & Pollack, 2002), and high internal consistency supports the coherence of the AtL scale itself (Rock & Pollack, 2002; Tourangeau et al., 2017).

Predictive evidence for the scale is abundant (Bodovski & Farkas, 2007; Claessens, Duncan, & Engel, 2009; Duncan et al., 2007; Li-Grining, Votruba-Drzal, Maldonado-Carreno, & Haas, 2010), however no studies have examined convergent or divergent relationships of scale scores with concurrent measures of related constructs. Additionally, despite its use in the ECLS-K across nine years of schooling, no evidence of longitudinal invariance has been published, nor have any studies been carried out to identify patterns of growth in AtL over time utilizing this scale.

Demographic and Parenting Correlates of AtL

Parents and the homes they create for their families are a child's first teachers and classroom. It is from their earliest experiences of parent-child interactions and explorations within and around the home that children form the foundational social, emotional, and cognitive skills they will take with them into kindergarten and later schooling (Chazan-Cohen et al., 2009; Hyson, 2008). Multiple facets of children's early development and school readiness have been linked with parent-child relationships and characteristics of the home environment.

Existing evidence points to three important elements of parents' involvement in shaping children's early learning experiences, and potentially influencing future approaches toward learning: (a) support for learning, (b) discipline and routines, and (c) engagement in education (Holden, 2010; Luster & Okagaki, 2005; Pomerantz, Grolnick, & Price 2005). Additionally, it is important to acknowledge the child characteristics and contextual factors that play a prominent role in shaping parents' behaviors and child outcomes. Thus, demographic characteristics including the child's gender and race, as well as family structure and SES must be taken into consideration.

Support for Learning

Parents perform the role of children's first teachers by providing stimulating experiences and supporting their learning in a variety of ways. This includes engaging directly with children in cognitively stimulating activities (e.g., talking, reading or playing games with the child) as well as providing opportunities for the child to explore and engage in novel experiences (Bornstein, 2002; Hyson, 2008; Pomerantz et al., 2005).

These types of activities serve to foster children's interest and engagement with learning at home, and prepare them for the classroom context (Landry, Smith, & Swank, 2003; Landry, Smith, & Swank, 2006). For example, Bodovski and Farkas (2008) found that parent involvement in activities with children at home and children's participation in extracurricular activities predicted teachers' ratings of children's AtL in a sample of white first graders.

Similarly, Fantuzzo, McWayne, Perry and Childs (2004) examined parents' home- and school-based involvement with children's learning in a sample of mostly African American urban Head Start children using the Family Involvement Questionnaire (FIQ; Fantuzzo, Tighe, & Childs, 2000). Their findings indicated that parents' involvement in home-based learning activities such as working on number skills, providing learning materials in the home, and doing creative activities with the child significantly predicted end-of-year teacher-rated learning behaviors (Fantuzzo et al., 2004). However, DeWar (2011), also using the FIQ, did not find a significant association between parent involvement and learning behaviors in a sample of predominantly suburban, white children attending public preschools in the Rocky Mountain region.

Discipline and Routines

Research affirms that optimal parenting involves a balance of affectionate responsiveness with authoritative control (Larzelere, Morris, & Harrist, 2013). Authoritative or "positive" parental control involves structuring the child's environment through the use of rules and routines, as well as disciplinary techniques that stress the use of reasoning; these practices help children to internalize regulatory processes and

understand the consequences of their behavior (Choe, Olson, & Sameroff, 2013; Clark et al., 2014; Phillips & Shonkoff, 2000). In contrast, parenting strategies characterized by harsh, restrictive, or intrusive control and physical punishment have been associated with poorer self-regulation, attention and executive function, and poorer classroom behavioral adjustment (Amato & Fowler, 2002; Barber, 2002; Clark et al., 2014; Olson, Lopez-Duran, Lunkenheimer, Chang, & Sameroff, 2011; Mathis & Bierman, 2012).

Engagement with Education

Finally, parents contribute to children's academic engagement and performance both through the attitudes and values they convey to their children, as well as direct involvement in their children's schools and classrooms. Parents' expectations for their children's ultimate educational attainment are associated both with greater parental involvement in schooling, and better educational outcomes for children (Galindo & Sheldon, 2012). Parents' involvement in children's schooling (e.g., attending school events, communicating with teachers, volunteering in the classroom) has been shown to predict children's academic engagement and performance in early childhood and elementary, with effects potentially lasting into high school and beyond (Barnard, 2004; Bodovski & Farkas, 2008; El Nokali, Bachman, Votruba-Drzal, 2010; Galindo & Sheldon, 2012; McWayne, Fantuzzo, & McDermott, 2004). As illustration, in a study of low-income preschoolers conducted by Arnold, Zeljo, and Ortiz (2008), parent involvement in preschool predicted children's early literacy skills. Their findings indicated that SES predicted levels of parent involvement, but that involvement remained significant in predicting literacy skills even after controlling for SES.

Demographics

Few studies have examined the demographic Correlates of AtL. However, existing evidence is consistent with research noting risks associated with sex, race, and SES for other child development and schooling outcomes. In a nationally representative sample of children ages 5 to 17 years, Schaefer (2004) found that males and students in special education were more likely to display maladaptive learning behaviors, as were children with parents who did not complete high school, African American children, and children residing in urban areas.

McDermott et al. (in press) obtained similar findings in their examination of longitudinal trajectories of AtL. Boys and children who had received special needs services were at greater risk for poorer AtL growth, whereas Hispanic and older children were at reduced risk. Bundy (2006) found that race and maternal education were significantly associated with AtL at kindergarten entry, whereas poverty status, child care, and residence were not. From these findings, it is difficult to determine the unique contributions of poverty, race, and low maternal education to AtL, since these are often highly intercorrelated.

Current Study

Study Rationale

This review of the literature highlights several points of clarity as well as gaps in current conceptual and empirical understanding of children's AtL. First, the conceptual underpinnings of AtL are solidly based in literatures relating to children's psychosocial development, particularly in the areas of self-regulation, executive function, and

motivation. Second, there appears to be substantial agreement with regard to the types of behaviors (e.g., paying attention, persisting in tasks, showing interest, etc.) that represent positive AtL. Additionally, there is significant evidence that AtL uniquely and significantly predict social and academic outcomes.

However, there remain discrepancies across definitions and measures of AtL. For instance, some of the measures described above include interpersonal relationships and attachment as dimensions of AtL, while others leave these constructs out. Some cover cognitive flexibility and other qualities of executive function, while others do not. It is also unclear how the various facets of AtL are expected to relate to one another and to the construct as a whole. For example, to the extent that AtL represents behavioral manifestations of social skills, emotion regulation, behavior regulation, motivation and cognitive flexibility, does it represent these constructs equally? Or do certain aspects carry more weight in defining the overall character of AtL? Secondly, are these constructs additive in nature, or is AtL greater than the sum of its parts?

In addition to these conceptual issues, there are also gaps in the empirical knowledge base on AtL. In particular, relatively little is known about the distribution of AtL in the general population, and whether there are typical patterns of growth and change over time. Studies to date have primarily examined AtL at a single point in time (usually preschool or kindergarten) as a predictor of future academic and behavioral outcomes and have often done so in racially and/or economically homogenous samples.

Finally, while there is substantial empirical support for the supposition that early parenting and home environments contribute to the development of key social, emotional

and behavioral competencies, few studies have examined the Correlates of AtL as a unified construct. Perhaps more important, those which have examined these influences have failed to control for the potentially confounding effects of race, SES and education.

Objectives and Research Questions

The current study has been designed to address these gaps in the literature. Study objectives and research questions are described below.

Objective 1: Examine the measurement properties of the ECLS-K AtL scale.

This study will examine the content and concurrent validity of the ECLS-K scale by exploring correlations of related measures (e.g., executive function, self-regulation, social skills) with AtL scores. It will also explore the viability of the scale for longitudinal measurement. Research questions include: (a) What is the magnitude and distribution of shared variance between AtL and related constructs? and (b) Does the scale demonstrate longitudinal invariance over three years from kindergarten through second grade?

Objective 2: Examine within-child variation in AtL over time. The study will explore whether and how individual children and latent subpopulations vary with regard to levels and change in AtL over time in a large, nationally representative, longitudinal sample of children. Research questions include: (a) Is there significant variation in children's levels and patterns of change in AtL from kindergarten to second grade? and (b) Are there latent subpopulations of AtL growth from kindergarten to second grade?

Objective 3: Explore family and parent Correlates of AtL growth. Finally, this study will seek to determine whether and which types of parent involvement during kindergarten predict children's AtL growth trajectories, controlling for important child

and family demographic factors. It will also explore the degree to which these factors increase or decrease children's risk for poorer patterns of AtL growth. Research questions include: (a) To what extent do child and family demographic factors predict AtL growth from kindergarten to second grade? and (b) To what extent do parenting factors predict AtL growth from kindergarten to second grade?

CHAPTER 2: METHODS

Data

Data for this investigation were drawn from the ECLS-K Class of 2010-2011, sponsored by the National Center for Education Statistics (NCES; Tourangeau et al., 2017). The ECLS-K provides detailed information about children in public and private schools from all regions of the country, beginning at kindergarten entry and continuing longitudinally through grade 5. Data collection, which comprises child assessments, teacher ratings, and parent interviews, occurs twice per academic year in the fall and spring semesters. The present study utilizes data from the public use data file for kindergarten through second grade, which includes six observation points: fall and spring of kindergarten (Fall K and Spring K), fall and spring of grade 1 (Fall 1 and Spring 1), and fall and spring of grade 2 (Fall 2 and Spring 2).

Sample

A clustered, multistage stratified sampling strategy was used to select primary sampling units, schools, and children to produce a nationally representative sample of over 20,000 students at the start of the 2010-2011 kindergarten year (Fall K). Some 18,174 of these students participated in the Fall K observation. Only students who participated in the Fall K observation were followed up in subsequent observations, and no schools or children were added to the sample after Fall K. At Fall 1, a subsample of the Fall K schools was selected via a three-stage procedure to produce a subsample representative of the full study sample. This subsample was followed up again at Fall 2.

Table 3 provides basic demographic information for the full sample and the Fall 1 subsample of students.

Table 3: *Sample Demographic Characteristics for Full Sample and Fall 1 Subsample*

	Full Sample		Fall 1 Subsample	
	<i>N</i>	Percent	<i>n</i>	Percent
Child sex ^a				
Male	9288	51.1	2639	52.6
Female	8847	48.7	2381	47.4
Child race ^b				
White, non-Hispanic	8495	46.7	1917	38.2
African American, non-Hispanic	2396	13.2	515	10.3
Hispanic	4585	25.2	1702	33.9
Other	2652	14.6	880	17.5
Household income ^c				
< 100% of poverty	3451	25.4	1090	27.7
100 - 200% of poverty	3006	22.1	818	20.8
> 200% of poverty	7070	51.9	2024	51.5
Parent education ^d				
8 th grade or below	781	4.9	278	7.1
9 - 12 th grade	1398	8.7	454	9.7
High school diploma/equivalent	3543	22.0	1005	27.2
Vocational program	893	5.6	207	4.3
Some college	4242	26.4	1083	19.7
Bachelor's degree	3129	19.5	857	18.0
Graduate school (no degree)	267	1.7	61	1.4
Master's degree (MA, MS) or higher	1752	10.9	502	12.7

Note. Values in bold font are statistically different from full sample proportions at $p < .01$.

^a Missing data for 39 children in full sample and 3 in Fall 1 subsample.

^b Missing data for 46 children in full sample and 9 in Fall 1 subsample.

^c Missing data for 84 children in full sample and 1091 in Fall 1 subsample.

^d Missing data for 83 parents in full sample and 576 in Fall 1 subsample.

Data Collection

At each of the six observation points, data were collected from schools, teachers, parents, and children regarding a variety of child- and school-level outcomes. Children's cognitive, social, emotional, and physical development were assessed through parent and teacher rating scales as well as direct assessments. Parents also provided information about family economic status and activities, family structure and relationships, the home environment, parent-child interactions, and use of community services including public assistance and child care.

Direct assessments of children's cognitive functioning were conducted one-on-one by trained assessors in schools, while teacher ratings were collected via paper-and-pencil self-administered questionnaires. Parents provided data primarily through computer-assisted telephone interviews, but some interviews were conducted in person.

Measures

A variety of child- and parent-level measures were employed in this investigation. Teacher ratings of children's AtL were used as the longitudinal dependent variable for identifying latent growth trajectories across the six observation points. Other child outcomes including directly assessed cognitive functioning and teacher-rated social, emotional, and behavioral outcomes were examined in relation to AtL. Finally, parent variables including characteristics of the home and family context, as well as parenting behaviors, were used as explanatory variables regressed onto latent growth classes to examine their contribution to differential AtL outcomes.

Child-Level Measures

Approaches to learning. At each observation, teachers completed the Social Rating Scale (SRS) for each child in the sample, assessing various aspects of children's social and behavioral functioning. The SRS was adapted for the ECLS-K from the widely used Social Skills Rating System (SSRS; Gresham & Elliott, 1990), with items added specifically to measure AtL. Exploratory and confirmatory factor analytic studies confirmed the existence of a subscale of the SRS capturing children's AtL. The scale includes seven items rated on a 4-point Likert scale indicating the frequency with which the child displays the following behaviors (*never* to *very often*): keeps belongings organized; shows eagerness to learn new things; works independently; easily adapts to changes in routine; persists in completing tasks; pays attention well; and follows classroom rules (Rock & Pollack, 2002). An earlier 6-item version of the scale was found to be internally consistent and reliable, with split-half reliability of .89, and test-retest reliability of .77 (Berry et al., 2004). No further information regarding the development or psychometric properties of the scale have been published.

Reading and math. Math and reading skills (i.e., letter recognition, vocabulary, number characteristics and patterns, etc.) were assessed via direct assessments in the ECLS-K. The assessments were developed using rigorous procedures to ensure content and construct validity based on frameworks created for the National Assessment of Educational Progress (NAEP) (U.S. Department of Education, 2002). Reading and math assessments were individually administered to sample children at each of the six observation points. Assessments were two-stage adaptive tests, whereby children were

routed to easier or harder item sets depending on their responses and were vertically equated so that scores could be computed and compared over time to measure growth in reading and math proficiency. Item response theory (IRT) scoring allowed comparable scores to be calculated for children who responded to different numbers and types (easier vs. more difficult) of test items. Internal consistency for both reading and math scores was quite high, with alpha coefficients ranging from .91 to .95 across all observations (Tourangeau et al., 2017).

Executive function. The Dimensional Change Card Sort (DCCS; Zelazo, 2006) was used to assess children's cognitive flexibility, a key dimension of executive function. In this task, children were asked to sort a set of cards according to a particular dimension, such as shape or color. In subsequent phases, they were asked to re-sort the cards based on a different dimension. In kindergarten and first grade rounds of assessment, the card sort was done manually on a tabletop; total scores represent the child's accuracy in sorting in each of the phases of the task. Beginning in Fall 2, a computerized version of the assessment was administered; Fall 2 and Spring 2 scores reflect the number of correct sorts as well as response time.

Social skills. In addition to AtL, teachers rated various dimensions of children's social skills and behavior using the SRS. As mentioned above, the SRS is an adaptation of the SSRS (Gresham & Elliott, 1990) created specifically for the ECLS-K in which certain items were taken verbatim, others were reworded, and new items were added. All items are rated on a 4-point scale from *never* to *very often*. Scores are available for four subscales including Self-Control (4 items), Interpersonal Skills (5 items), Externalizing

Problem Behaviors (6 items), and Internalizing Problem Behaviors (4 items). Subscale scores were computed as the mean rating across items of each subscale for students who had at least 3 or 4 (depending on the number of items in the scale) responses per scale. Internal consistency (α) coefficients for the scales ranged .79-.82 for Self-Control, .85-.88 for Interpersonal Skills, .86-.89 for Externalizing, and .73-.79 for Internalizing Problem Behaviors (Tourangeau et al., 2017).

Self-regulation. Teachers also rated children's self-regulation using adaptations of the Short Form of the Child Behavior Questionnaire (CBQ; Putnam & Rothbart, 2006) in kindergarten and first grade and the Temperament in Middle Childhood Questionnaire in second grade (TMCQ; Simonds & Rothbart, 2004). The CBQ (12 items) and TMCQ (13 items) assess two dimensions of self-regulation: Attentional Focusing and Inhibitory Control. CBQ items were rated on a 7-point Likert scale from *extremely untrue* to *extremely true*, while TMCQ items were rated on a 5-point scale from *almost always untrue* to *almost always true*. Scale scores were computed as the mean rating across items of each subscale for students who had at least 4 responses per scale. Internal consistency reliability (α) for the scales ranged .83-.96 for Attentional Focusing and .86-.87 for Inhibitory Control (Tourangeau et al., 2017).

Parent Involvement Measures

Support for learning. Measures related to parent support for learning were taken from the Fall K and Spring K parent questionnaires. Fall K items included several questions rated on a 4-point Likert scale describing the frequency with which the parent or another family member engaged in the following activities with the child during a

typical week: telling stories; singing songs; playing games or doing puzzles; helping the child do arts and crafts; involving the child in household chores; building something or playing with construction toys; talking about nature or doing science projects; playing a sport or exercising together; reading books; and practicing reading, writing, or working with numbers.

Spring K items included questions about whether anyone in the family had done the following with the child in the past month (*yes* or *no*): visited a library; visited a bookstore; gone to a play, concert or other live show; visited an art gallery, museum or historical site; visited a zoo, aquarium, or petting farm; attended an athletic or sporting event in which the child was not a player.

Discipline and routines. Other questions in the parent questionnaire included items related to disciplinary practices and household routines. Parents were asked whether they had spanked the child in the past week; whether there were family rules about the types of programs and amount of time the child was permitted to watch; how many nights in a typical week the family ate dinner together; and whether the child had a regular bedtime.

Engagement with education. At Fall K, parents were asked how far they expected their child to go in school with response options ranging from *less than a high school diploma* to *a Ph.D., MD or other advanced degree*. Additionally, parents responded to several items at Spring K indicating whether they or another adult in the household had participated in activities at the child's school since the start of the school year (*yes* or *no*) including: a parent-teacher conference; back-to-school night; a parent

advisory group meeting; a parent-teacher association meeting; a school or class event (e.g., play, sports event or science fair); volunteering at the school; serving on a school committee; or assisting with fundraising.

Analyses

Longitudinal Scaling of AtL

Missing data. Missing data on the AtL scale were evident at both case level (children for whom no AtL data were available at a given observation point) and item level (one or more AtL items were missing for children that had some data at a given observation point). Case-level missing was primarily attributable to the sampling design of the ECLS-K, whereby data were collected from a representative subsample of children at the Fall 1 and Fall 2 observations. A smaller proportion of case-level missing resulted from study attrition. Table 4 gives the number and percent of the full Fall K sample ($N = 18,174$) for which teacher-rated AtL data were available at each observation point, and the percent of those cases that had complete item-level AtL data.

Table 4: *Nonmissing and Complete Cases by Observation*

	<i>n</i>	Percent nonmissing	Percent complete
Fall K	14793	81.4	98.9
Spring K	16012	88.1	99.6
Fall 1	5023	27.6	99.7
Spring 1	13549	74.6	99.7
Fall 2	4515	24.8	99.4
Spring 2	12707	69.9	99.7

Item-level missing was handled using Markov Chain Monte Carlo (MCMC) multiple imputation (MI) as recommended by Rubin (1987) and Schafer (1997). Fifty

imputed data sets were generated for each of the six observation points, using only the nonmissing cases at each point, and imputed values were averaged across all 50 sets and rounded to the nearest integer value. Imputed values that were outside the range of possible responses (e.g., 1 to 4) were corrected to the minimum or maximum possible response. The imputation process ultimately produced six imputed data sets (one per observation point), each with complete item-level data for AtL items, from which scale scores were computed (as described below).

Case-level missing on AtL was accounted for using full information maximum likelihood (FIML) estimation in *Mplus* version 8 (Muthen & Muthen, 2015). Whereas with MI, missing values are directly estimated and entered into statistical models along with raw values, FIML estimates model parameters (i.e., covariance structure) based on all available data (Raykov, 2005). This approach is preferable to listwise deletion, pairwise deletion or mean imputation, which can produce biased estimates (Enders & Bandalos, 2001; Wothke, 2000).

Scoring. IRT scaled scores (*SSs*) were generated for AtL in PARSCALE (Muraki & Bock, 1997) using the imputed data sets for each observation point. Both graded response and partial credit response models were tested. Fall K data was used to calibrate Bayesian Expected a Posteriori (EAP; Thissen & Wainer, 2001) scores with the mean centered at 50 and a standard deviation of 10. Scoring parameters from this calibration were then applied to the remaining datasets (Spring K to Spring 2) to obtain scores that reflected change in AtL over time.

Longitudinal Measurement Invariance

Before a measure can be examined longitudinally, it is necessary to ensure that its psychometric properties remain constant over time. In the case of the AtL scale, it was necessary to verify (a) that all scale items loaded onto a latent factor at all observation points (configural invariance), (b) that the item loadings were similar across observations (metric invariance), and (c) that intercepts were similar across observations (scalar invariance) (Cheung & Rensvold, 2002).

A baseline latent variable model was constructed in *Mplus* version 8 (Muthen & Muthen, 2015), specifying a latent AtL factor for each of the six observation points. Subsequent models constrained of item loadings on the AtL factors to be equal over time, and then intercepts. Because chi-square tests tend to be sample size dependent, evaluation of model fit was based on the Comparative Fit Index (CFI) (Bentler, 1990), Tucker-Lewis Index (TLI; Tucker & Lewis, 1973) and Root Mean Squared Error of Approximation (RMSEA), with CFI/TLI > .90 and RMSEA < .05 constituting adequate fit (Browne & Cudeck, 1992; Cheung & Rensvold, 2002). Finally, internal consistency coefficients (α) were calculated for the scale at each observation point.

Concurrent Validity of the ECLS-K AtL Scale

Canonical correlation analyses (Thorndike, 2000) were performed to examine associations between AtL and other child outcomes captured in the ECLS-K, including reading, math, social skills, self-regulation, and executive function scores. Canonical structure loadings were used to assess the distribution and magnitude of shared variance between AtL and validation measures. For the purposes of these analyses, structure

loadings of .80 or greater were considered salient in defining the canonical variate. Squared semipartial correlations were calculated in order to quantify the proportion of variance in each of the validation measures explained by AtL. Finally, redundancy analyses were conducted to capture the total amount of variation in AtL explained by the weighted set of validation measures and vice versa. Separate analyses were conducted for the Spring K, Spring 1 and Spring 2 observations, with the single AtL *SS* for each observation point compared against the set of scores for other outcomes.

Latent Growth Mixture Models

To explore the distribution and variance of AtL in the study population and development of AtL over time, a series of latent growth mixture models (LGMM) (Duncan, Duncan, & Strycker, 2006; Ram & Grimm, 2009) was tested using *Mplus* version 8 (Muthen & Muthen, 2015). In these models (see Figure 1), AtL *SSs* were entered as observed variables (T1 through T6), with Intercept (F1) and Slope (F2) modelled as latent variables describing growth in AtL over time, and Class (C) as a latent variable described by Intercept and Slope. Fixed basis linear and polynomial models were tested as well as latent basis models with one to four latent classes.

Model fit was assessed using (a) Aikake's Information Criterion (AIC) and Schwarz's Bayesian Information Criterion (BIC) (Nylund, Asparouhov, & Muthen, 2007), (b) Integrated Classification Likelihood with Bayesian-type Approximation (ICL-BIC; McLachlan & Peel, 2000), (c) entropy and average posterior classification accuracy values (Greenbaum, Del Boca, Darkes, Wang, & Goldman, 2005; Nagin, 1999), (d) likelihood ratio tests including the Vuong-Lo-Mendell-Rubin (VLMR), Lo-Mendell-

Rubin (LMR), and parametric bootstrap (via 100 draws) likelihood ratio tests (LRT; Nylund et al., 2007), and (e) theoretical coherence (Ram & Grimm, 2009).

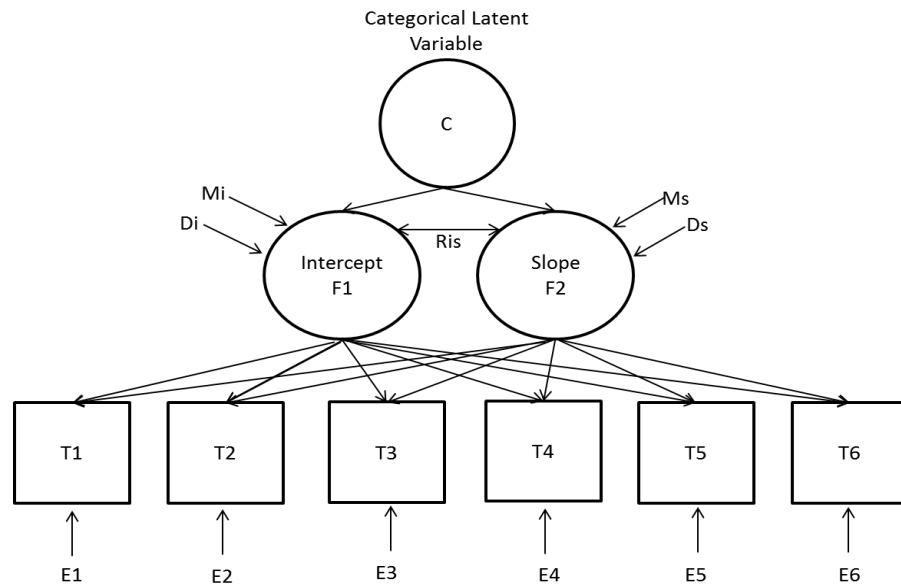


Figure 1: Latent growth mixture model diagram.

Demographic and Parenting Correlates of AtL

Factor analysis. Exploratory and confirmatory factor analyses were conducted on randomly split subsamples of parent questionnaire data to create a composite measure of parent involvement at kindergarten. Using the exploratory subsample, self-report items relating to parents' support for learning in the home, provision of cognitively stimulating experiences outside the home, and participation in activities at the child's school were entered into full-information item factor analysis using TESTFACT (Wilson, Wood, & Gibbons, 1998). TESTFACT is ideal for dichotomous and polytomous data, as it utilizes

a smoothed tetrachoric correlation matrix. Iterated common-factor models were rotated toward simple structure using promax rotation.

Factor models were evaluated according to (a) the number of items retained by each solution, (b) simple structure, (c) the number of salient items per factor (three items minimum), (d) internal consistency reliability for each extracted factor ($> .70$), and (d) logical and theoretical interpretation of extracted factors (Fabrigar, Wegener, MacCallum, & Strahan, 1999). Solutions that met these criteria in exploratory analyses were subjected to confirmatory factor analysis using the confirmatory subsample. Fit criteria for confirmatory models included $RMSEA < .05$ (Browne & Cudeck, 1992) and $CFI > .90$ (Cheung & Rensvold, 2002).

Logistic Regression. Binary variables were created for child sex, race (African American vs. non-African American), and ethnicity (Hispanic vs. non-Hispanic). Household SES was captured in binary variables for: poverty, defined as household income below 100% of the federal poverty line; low income, defined as household income between 100% and 200% of the federal poverty line; low parental educational attainment (i.e., less than a high school diploma or equivalent); and use of public assistance (Temporary Assistance for Needy Families [TANF] or food stamps) in the past year. Finally, family structure was captured in a binary variable indicating whether both biological parents lived in the household.

Parent reports of spanking and educational expectations were likewise converted into binary variables for the purposes of regression analyses. The spanking item, which asked parents to indicate the number of times they had spanked the child in the past

week, was converted into a dichotomous indicator distinguishing parents who had not spanked the child at all from parents who had spanked the child one or more times. With regard to parents' expectations for their child's educational attainment, responses were dichotomized to discriminate between parents who expected their child to obtain at least a 4-year college degree, and those who had lower expectations.

To examine the effect of demographic characteristics and parent involvement on children's AtL, explanatory covariates were regressed onto latent growth classes (see Figure 2). The procedure used corresponds with a 3-step approach described by Asparouhov and Muthen (2014). In the first step, the growth model was estimated without covariates to identify appropriate curves and number of latent classes. In the second step, classification probabilities were used to assign each child to his or her most likely latent class. Finally, explanatory covariates were regressed onto the nominal latent class variable, using the latent class logit values to account for the level of uncertainty associated with class assignments from step 2. Resulting regression coefficients for each of the explanatory variables were converted into odds ratios signaling a child's relative risk of being classified into one latent class versus another.

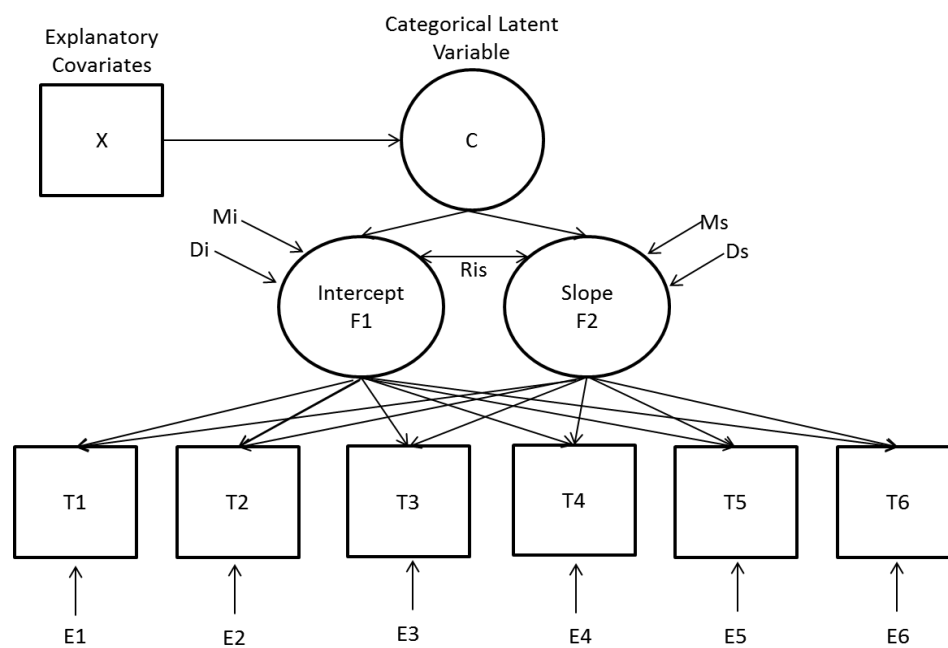


Figure 2: Latent growth mixture model with explanatory covariates diagram.

CHAPTER 3: RESULTS

Longitudinal Scaling of AtL

For imputation of item-level missing data, efficiency was greater than .99 for all items at all observation points, and final imputed data sets showed no appreciable changes in item means, standard deviations, skewness or kurtosis, indicating that imputation did not substantively change the distribution of the raw data. The imputation process ultimately produced one final data set per observation point, each with complete item-level data for the AtL scale.

IRT *SSs* were generated for AtL in PARSCALE (Muraki & Bock, 1997) from the imputed data sets for each observation point. Both graded response and partial credit response models were tested, and graded response was selected because it produced slightly higher slopes and total test information values. The graded response threshold parameters for AtL items ranged .23-1.33 ($M = .84$, $SD = .43$) and slopes 1.00-2.23 ($M = 1.64$, $SD = 0.42$). Item characteristic curves showed that response categories were properly ordered (see appendix Figure A1) and the test information and standard error overlay plot (see appendix Figure A2) showed adequate discrimination across the ability distribution. Internal consistency of the scale (α) was $> .90$ at all observation points.

Fall K data was used to calibrate Bayesian Expected a Posteriori (EAP) scores with the mean centered at 50 and a standard deviation of 10. Fall K parameters were then applied to each of the remaining observations, and scores were converted to *T* scores. Means and standard deviations for each observation point are shown in Table 5.

Table 5: *AtL Scaled Score Means and Standard Deviations by Observation Point*

	Mean	<i>SD</i>
Fall K	50.00	10.00
Spring K	52.20	9.85
Fall 1	51.33	9.67
Spring 1	53.02	10.00
Fall 2	51.55	9.73
Spring 2	52.00	10.11

Longitudinal Measurement Invariance

All three invariance models (configural, metric, and scalar) demonstrated good fit with the data, producing CFI/TLI values $> .95$ and RMSEA $< .05$, indicating strong invariance (Cheung & Rensvold, 2002). This affirmed that the AtL scale is longitudinally invariant, permitting the application of growth mixture modeling to examine AtL growth over time.

Table 6: *Longitudinal Invariance Model Fit Statistics*

	CFI	TLI	RMSEA
Configural	.968	.961	.029
Metric	.964	.957	.031
Scalar	.966	.962	.029

Concurrent Validity of the ECLS-K AtL Scale

Canonical correlation analysis examined the shared variance between AtL and a set of other child outcomes that were used to assess convergent and divergent relationships. Canonical analyses are typically performed on two sets of variables. In this case, the first set (“AtL”) had only one variable: the AtL *SS*. The second set (the “validation set”) consisted of children’s scores on teacher-reported and direct measures

self-regulation, social-emotional skills, and cognitive functioning (see Table 7). Each analysis indicated that AtL and the validation measures shared significant variance, with multiple $R = .90$ at each occasion. At Spring K, Wilks' lambda = .194, where $F(9,15261) = 7038.75$ and $p < .0001$. At Spring 1, Wilks' lambda = .193, where $F(9,12775) = 5295.95$ and $p < .0001$. At Spring 2, Wilks' lambda = .186, where $F(9,12117) = 5893.77$ and $p < .0001$.

Canonical structure. Structure loadings of the variables in the validation variate represent regression weights applied to the variables in order to maximize the correlation of the variate with AtL (Weiss, 1972), in essence providing a picture of the degree to which AtL *SSs* capture each of the component constructs thought to comprise AtL. As shown in Table 7, CBR/TMCQ scores for Inhibitory Control and Attentional Focusing loaded most saliently onto the variate, followed by SRS ratings for Interpersonal Skills and Self-Control.

As expected, Internalizing Problem Behaviors and Externalizing Problem Behaviors were negatively correlated with the other measures in the validation variate and with AtL. Measures of cognitive functioning including math and reading scores did not load saliently, although they were statistically significant. Cognitive flexibility as measured by the DCCS was the only variable that did not correlate significantly with other validation measures until Spring 2, when the assessment was administered by computer and scores were calculated using measures of both accuracy and response time (as described in the Measures section).

Table 7: *Canonical Structure and Semipartial Correlations Between ECLS-K AtL Scores and Validation Measures*

Validation variables	Spring K	Spring 1	Spring 2
Canonical structure loadings for the validation variate			
CBQ/TCMQ scale scores			
Attentional Focus	0.908	0.896	0.932
Inhibitory Control	0.902	0.897	0.860
SRS scale scores			
Interpersonal Skills	0.809	0.793	0.797
Self-Control	0.798	0.773	0.773
Internalizing Problem Behaviors	-0.374	-0.404	-0.459
Externalizing Problem Behaviors	-0.686	-0.688	-0.693
Direct assessments			
Math	0.462	0.459	0.441
Reading	0.449	0.523	0.472
DCCS (cognitive flexibility)	0.205 [†]	0.208 [†]	0.303
Squared semipartial correlations (predicting validation variables from AtL)			
CBQ/TCMQ scale scores			
Attentional focus	0.665	0.648	0.707
Inhibitory control	0.656	0.649	0.602
SRS scale scores			
Interpersonal Skills	0.528	0.508	0.517
Self-Control	0.513	0.482	0.487
Internalizing Problem Behaviors	0.113	0.132	0.171
Externalizing Problem Behaviors	0.379	0.382	0.391
Direct assessments			
Math	0.172	0.170	0.158
Reading	0.162	0.221	0.181
DCCS (cognitive flexibility)	0.034	0.035	0.075

Note. All estimates are statistically significant at $p < .0001$ unless indicated by the [†] symbol.

Squared semipartial correlations. Squared semipartial correlations represent the proportion of variance in each of the validation variables explained by AtL, after removing the effects of all other variables. At all three observation points, AtL explained a significant percentage of the variance in each of the validation variables. Following the pattern of the structure loadings, AtL predicted the largest amount of variance for CBQ/TCMQ variables, with AtL explaining an average of 67.3% of the variance in Attentional Focusing and 63.6% of variance in Inhibitory Control over the three years. AtL also explained large amounts of variance in Interpersonal Skills (51.8%), Self-Control (49.4%) and Externalizing Problem Behaviors (38.4%) averaged over three years. AtL predicted an average of 13.9% of variance in Internalizing Problem Behaviors, and only 13.4% of variance in measures of reading and math achievement (combined) over the three observation points. AtL predicted less than 5% of the variance in cognitive flexibility.

Redundancy analysis. Redundancy analysis provides the total amount of variance in each of the two variable sets explained by the variables in the other set. AtL predicted 100% of the variance in the AtL variate (being the only variable in the set), and 36.1% of the variance in the set of validation measures. On the other hand, validation variables explained 44.4% of the variation in the validation variate, but 80.9% of the variance in AtL.

Latent Growth Mixture Models

Because of the large amount of missing case-level data at Fall 1 and Fall 2, LGMM (Duncan et al., 2006; Ram & Grimm, 2009) were run and compared for the full

study sample, the Fall 1 subsample, and a subset of the observation points (e.g., excluding Fall 1 and Fall 2) to test the effects of missing data on the estimation of latent growth trajectories and classes. Each sample yielded similar results, with only slight differences in entropy and classification probabilities across samples. It was determined that the subsample of children present at the Fall 1 data collection should serve as the analytical sample for this study for two reasons: (a) the use of this sample minimized the amount of missing data in the model; (b) the subsample was randomly selected and representative of the full sample of schools. Alternatively, a subsample consisting of only those children who had been present at all six observations would eliminate missing data concerns but would be neither random nor representative of the full sample.

An initial single-class growth model demonstrated that significant variance in random intercepts and slopes existed within the student population. Fixed-basis models were consistently better fitting than latent-basis models. Fixed-basis models revealed significant linear, quadratic and cubic curvatures. However, variance of the cubic curvature variable was near zero and estimation often produced negative covariances, therefore it was fixed at 0 in all models. Residuals were constrained to be equal across observation points, since freeing them did not noticeably improve model fit.

Properties, fit statistics, and parameter estimates for the LGMM are shown in Table 8. The 4-class model demonstrated the lowest BIC values, as well as significant improvement over the 3-class model in LRT tests. However, the ICL-BIC, which has been shown to identify the optimal solution even when covariances are misspecified (Fruhwirth-Schnatter, 2006, pp. 214-215; McLachlan & Peel, 2000, pp. 217-220),

indicated that the 2-class model provided the best fit. The 2-class model also demonstrated higher average classification probabilities than the 3- and 4-class models and significant VLMR and LMR LRT tests comparing it to the 1-class model.

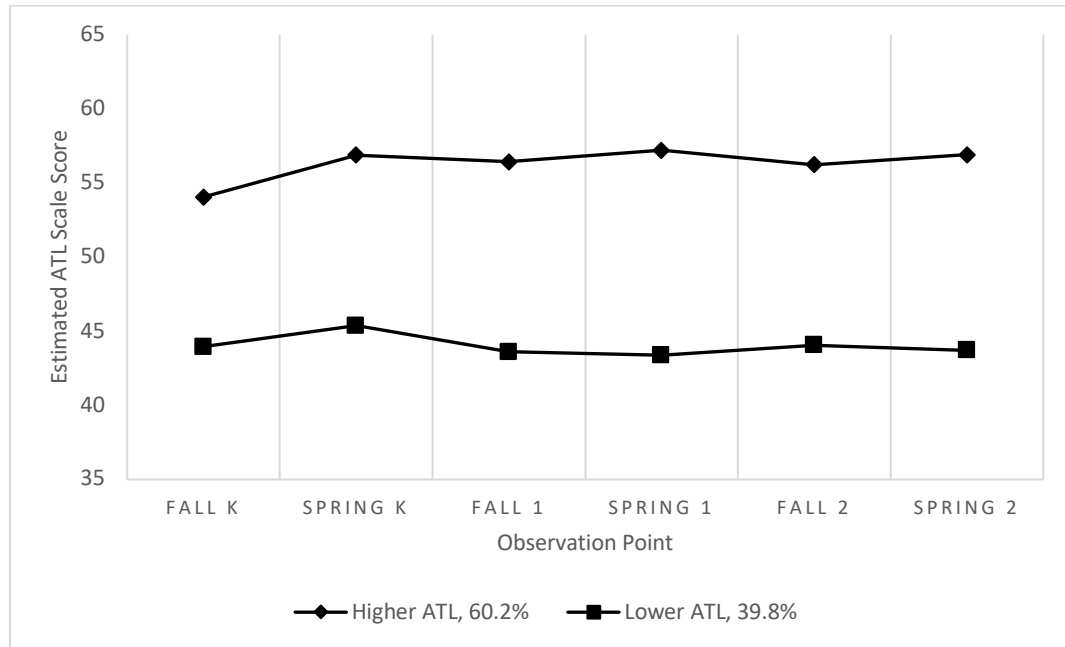


Figure 3: Estimated latent growth trajectories for AtL over six observations from fall of kindergarten through spring of second grade.

Resulting latent growth trajectories represented two subpopulations of children, one with relatively high AtL that increases slightly over time (Higher AtL class, $n = 3,023.5$), and a second with relatively low AtL (Lower AtL class, $n = 1,999.5$) that stays roughly the same over time (Figure 3). While there was some fluctuation in AtL within and between school years in both groups, the Higher AtL group SSs tend to hover around a half *SD* above the mean and the Lower AtL group a half *SD* below.

Table 8: *Properties and Parameter Estimates for Latent Growth Mixture Models*

	1-Class model	2-Class model	3-Class model	4-Class model
Sample				
Class 1	5023.00	3023.50	2060.40	931.01
Class 2		1999.50	1041.33	1194.64
Class 3			1921.27	997.87
Class 4				1899.48
Fit statistics				
# Free parameters	11	16	21	26
Akaike's Information Criterion (AIC)	186234	185983	186039	185806
Schwarz's Bayesian Information Criterion (BIC)	186306	186088	186039	185975
Sample size adjusted BIC (ABIC)	186271	186037	185972	185893
Integrated Classification Likelihood (ICL-BIC)		188894	190156	191935
Entropy		.597	.627	.572
Average class membership posterior probability		.875	.823	.727
Vuong-Lo-Mendell-Rubin LRT, p		<.0000	.0597	.0006
Lo-Mendell-Rubin LRT, p		<.0000	.0628	.0007
Parametric bootstrap LRT (via 100 draws), p		<.0000	<.0000	<.0000
Latent variable means				
Class 1 intercept	50.20 (0.15)	54.33 (0.34)	48.85 (0.42)	45.25 (0.82)
Class 1 linear slope	2.44 (0.16)	3.26 (0.29)	3.31 (0.34)	-0.09 (0.71) [†]
Class 1 quadratic slope	-1.04 (0.08)	-1.21 (0.12)	-1.39 (0.16)	0.20 (0.29) [†]
Class 1 cubic slope	0.12 (0.01)	0.13 (0.02)	0.15 (0.02)	0.00 (0.03) [†]

Table 8 (continued)

Class 2 intercept	43.95 (0.55)	41.88 (0.75)	51.39 (0.61)	
Class 2 linear slope	1.19 (0.39)	1.68 (0.67)	5.78 (0.59)	
Class 2 quadratic slope	-0.77 (0.17)	-1.07 (0.32)	-2.55 (0.27)	
Class 2 cubic slope	0.11 (0.02)	0.12 (0.03)	0.25 (0.03)	
Class 3 intercept		56.15 (0.39)	41.99 (0.61)	
Class 3 linear slope		1.92 (0.47)	1.86 (0.51)	
Class 3 quadratic slope		-0.65 (0.17)	-1.17 (0.25)	
Class 3 cubic slope		0.10 (0.02)	0.13 (0.03)	
Class 4 intercept			56.18 (0.38)	
Class 4 linear slope			1.89 (0.35)	
Class 4 quadratic slope			-0.63 (0.14)	
Class 4 cubic slope			0.09 (0.02)	
Latent variable variances and covariances				
Intercept	75.60 (1.94)	49.38 (4.07)	47.59 (4.32)	43.48 (3.36)
Linear slope	14.52 (0.85)	13.76 (0.93)	14.25 (0.85)	13.89(0.96)
Quadratic slope	0.42 (0.03)	0.40 (0.03)	0.40 (0.04)	0.33 (0.96)
Cubic slope	0.00 [fixed]	0.00 [fixed]	0.00 [fixed]	0.00 [fixed]
Intercept by linear slope	-13.39 (1.02)	-17.76 (1.32)	-14.09 (1.64)	-15.86 (1.30)
Intercept by quadratic slope	1.62 (0.18)	2.29 (0.25)	1.06 (0.37)	1.68 (0.24)
Intercept by cubic slope	0.00 [fixed]	0.00 [fixed]	0.00 [fixed]	0.00 [fixed]
Linear slope by quadratic slope	-2.27 (0.15)	-2.15 (0.16)	-2.22 (0.16)	-2.06 (0.18)
Quadratic slope by cubic slope	0.00 [fixed]	0.00 [fixed]	0.00 [fixed]	0.00 [fixed]
Linear slope by cubic slope	0.00 [fixed]	0.00 [fixed]	0.00 [fixed]	0.00 [fixed]
Residual variances	29.78 (0.41)	29.78 (0.41)	29.76 (0.41)	29.59 (0.42)

Note. LRT = Likelihood Ratio Test. All parameter estimates are statistically significant unless indicated by the † symbol. Estimated standard errors are shown in parentheses

Demographic and Parenting Correlates of AtL

Factor Analysis

Factor analysis was conducted with sets of items from the Fall K and Spring K parent questionnaires in an attempt to construct a composite variable for parent involvement. Since the Fall K and Spring K items were different in content and were captured on different scales (4-point Likert vs. dichotomous, respectively), separate factor analyses were conducted on each set. Fall K items related to parent support for learning at home were included in one analysis, and Spring K items addressing provision of cognitively stimulating experiences outside the home, discipline and routines in the home, and parent participation in school activities were entered into a second analysis.

Neither set of items produced a factor solution satisfying minimum criteria. Resultant solutions retained too few salient items and/or demonstrated poor reliability ($\alpha < .70$). For Fall K items, a 1-factor solution met criteria in the exploratory stage but failed to achieve minimum internal consistency in the confirmatory analysis. Bifactor analyses were also unsuccessful in producing reliable general or specific factors. As such, it was necessary to conduct logistic regressions using individual indicators of parent involvement as explanatory covariates (described below).

Logistic Regression

Demographic characteristics were entered into logistic regressions as explanatory covariates with latent class membership (Higher AtL v. Lower AtL) as the dependent variable. (See appendix Table B1 for means and correlation coefficients for all variables included in the regression.) As shown in Table 9, significant child characteristics

included child sex (male v. female) and race (African American v. all others), which both proved to be risk factors for membership in the Lower AtL class. Boys and African American children were more likely to be in the Lower AtL class at ratios of 5.6:1 and 1.5:1 when compared with girls and other racial groups, respectively. Household income below the federal poverty line and use of public assistance in the past year were likewise associated with increased odds of membership in the Lower AtL group. On the other hand, the presence of both biological parents in the household served to reduce the risk of membership in the Lower AtL trajectory by more than 50%. Hispanic ethnicity, low parent education and household income between 100% and 200% of the poverty line were not statistically significant, and thus are not shown in Table 9.

In the absence of composite variables representing kindergarten parent involvement, a small set of parenting indicators served as explanatory variables in the regression analyses. While it may appear desirable to examine the full range of parent behaviors captured in the parent questionnaire to determine which variables best predict children's AtL trajectories, this strategy would have been problematic from a statistical standpoint. The greater the number of variables in the model (and thus the number of statistical comparisons being performed), the greater the chances of spurious findings of significance.

Consequently, a few select items representing parents' support for learning in the home and engagement with education were chosen as explanatory covariates for the analysis. Indicators were selected from sets of items dealing with parents' support for learning at home (e.g., reading books, building things, etc.) and parent participation in

school activities. With regard to home-based support for learning, indicators were selected that represented the most direct *prima facie* relationship to children's development of language and literacy, numeracy, spatial and logical reasoning, and motor skills. Specifically, items for reading books, practicing numbers, talking about nature or science, playing games, and building things were included, whereas items related to arts and crafts, household chores, and playing sports were not. Items were converted from 4-point scale into binary values representing lower versus higher frequency (*never/once or twice per week* vs. *3-6 times per week/every day*).

In addition to the spanking item, questions related to discipline and household routines included items asking whether the family ate dinner together every night in a typical week, and whether the child had a regular bedtime. From the set of items asking about parent participation in school activities, three items – attending a parent-teacher organization meeting, volunteering at school, and helping with fundraising activities – were selected based on their distributions. Items for which there was very little variation were excluded (i.e., more than 70% of parents endorsed the item). As noted above, dichotomized indicators relating to spanking and parent expectations for the child's educational attainment were included due to their prominence as predictors of important child outcomes in the empirical literature (Clark et al., 2014; Galindo & Sheldon, 2012; Olson et al., 2011; Mathis & Bierman, 2012).

Parent involvement indicators were subsequently added into the logistic regression model alongside demographic characteristics, so that effects of parenting behaviors shown in Table 9 are controlled for these characteristics. Activities such as

building with the child, talking about nature or science, reading books to the child, practicing numbers, and attending a school event were not found to predict AtL class membership. However, playing games or working puzzles with the child at least three times in a typical week reduced the odds of a child's membership in the Lower AtL group by about 30%. Similarly, parents' expectation that their child would earn at least a 4-year college degree and having volunteered at the child's school during the kindergarten year each reduced the risk of membership in the Lower AtL category by more than 40%. On the other hand, reported spanking in the past week increased a child's risk of membership in the Lower AtL trajectory by more than 40%. It is notable that when parenting variables were entered into the model, race was no longer found to be significant, though it was retained as a control.

Table 9: Odds for Lower AtL vs. Higher AtL by Demographic Characteristics and Kindergarten Parent Involvement

Explanatory variable	Odds ratio (95% confidence limits)	% Risk increment ^a	% Risk reduction ^b
Demographic characteristics			
Child is male	5.1 (3.7/7.1)	410.9	
Child is African American	1.5 (1.0/2.2) [†]		
Household used public assistance	1.6 (1.1/2.3)	61.1	
Household income < 100% of poverty line	1.5 (1.0/2.2)	46.1	
Two biological parents in household	0.6 (0.4/0.8)		43.5
Kindergarten parent involvement			
Build things with child	1.3 (1.0/1.8) [†]		
Talk about nature, science with child	0.9 (0.7/1.2) [†]		
Play games, worked puzzles with child	0.7 (0.5/1.0)		29.9
Read books to child	1.2 (0.9/1.6) [†]		
Practice numbers, counting with child	0.7 (0.4/1.2) [†]		
Spanked child in past week	1.5 (1.1/2.0)	45.1	
Ate dinner together every night past week	1.1 (0.8/1.5) [†]		
Child has regular bedtime	0.8 (0.5/1.3) [†]		
Expects child to obtain 4-year college degree	0.6 (0.4/0.8)		43.4
Attended PTO meeting	1.0 (0.7/1.3) [†]		
Volunteered at school	0.6 (0.5/0.8)		38.6

Note. Values are estimated through logistic regression applying the generalized logit link function, where the latent growth classes are regressed simultaneously on explanatory variables and Higher AtL is the reference group. Results are statistically significant at $p < .05$ unless indicated by the [†] symbol.

^aEntries equal odds ratio - 1 (100).

^bEntries equal 1 - odds ratio (100)

CHAPTER 4: DISCUSSION

Summary of Findings

The current study aimed to address key gaps in current understanding of AtL with regard to its measurement and patterns of variation in the general population. Data for the study came from the ECLS-K 2010-2011 cohort, a large, nationally representative longitudinal sample. First, the study sought to examine the measurement properties of the ECLS-K AtL scale, both to establish its suitability for longitudinal analyses and to shed light on the relative contributions of social, emotional, and cognitive aspects of children's development to AtL scores (Objective 1). Second, variation in AtL from kindergarten to second grade was explored for individual children as well as latent subpopulations, illuminating the distribution and typical patterns of change in AtL in the general population of kindergarten and early elementary students (Objective 2). Finally, analyses of demographic and parenting Correlates of AtL as measured in kindergarten were assessed relative to subpopulations of children with higher versus lower AtL growth patterns in order to shed light on the mechanisms by which early childhood environments influence differential development of AtL for children of diverse racial and socioeconomic backgrounds (Objective 3). Findings with regard to the three study objectives and related research questions are summarized here.

Previous research established the factor structure of the teacher-rated measure of social skills employed in the ECLS-K, including the 7-item subscale capturing AtL (Rock & Pollack, 2002). The present study confirmed the integrity of the scale through confirmatory factor analyses examining scale structure across all six observation points

from Fall K to Spring 2. These analyses showed that all seven items loaded saliently onto the scale at each point, with relatively equal loadings and intercepts, and thus met the minimum criteria for strong factorial invariance (Cheung & Rensvold, 2002).

Canonical correlation analyses comparing AtL *SSs* to scores on concurrent measures of self-regulation, executive function, social skills, behavior problems, and reading and math achievement were conducted for each of three academic years: kindergarten, first grade and second grade. Results were consistent across all three years, with significant correlations between AtL and all validation measures with the exception of cognitive flexibility at kindergarten and first grade (multiple $R = .90$). Results revealed that teacher-rated measures of attention, self-regulation, and social skills were the largest contributors to the association between AtL and concurrent measures, internalizing and externalizing behavior were negatively correlated with AtL, and measures of achievement and cognitive flexibility contributed least to the association.

Growth mixture models revealed significant random variance in initial levels of AtL (intercepts), as well as linear, quadratic and cubic change parameters (slopes). Latent growth models revealed two latent subpopulations characterized by Higher AtL (about a half *SD* above the mean) and Lower AtL (about a half *SD* below the mean) which remained relatively stable over the three years from kindergarten to second grade. Approximately 60% of the sample was categorized in the Higher AtL group, and 40% in the Lower.

Latent classes of AtL growth were then regressed onto demographic and parenting involvement indicators in order to uncover important sources of variation in

children's AtL. As expected, sex (male), race (African American), poverty, and use of public assistance were significant risk factors for membership in the Lower AtL trajectory, while the presence of both biological parents in the household offered significant protective advantage. Parenting behaviors including playing games and doing puzzles with children at least three times a week, volunteering at the child's school, and parent expectation of high educational attainment were predictive of membership in the Higher AtL trajectory, while having spanked the child in the past week was a risk factor for Lower AtL.

Measurement Properties of the ECLS-K AtL Scale

The results of this study provide considerable psychometric support for the ECLS-K AtL scale. Analyses supported the concurrent validity and longitudinal invariance of the scale, suggesting that the scale presents an accurate and reliable picture of relevant learning-related behaviors in kindergarten through second grade. With correlation coefficients between AtL scores and teacher-rated measures of children's self-regulation, attention, and social skills surpassing .70, in some cases reaching or exceeding .90, it is clear that the AtL scale is representative of some of the major constructs thought to define AtL. AtL scores were also significantly correlated with children's reading and math proficiency, as well as internalizing and externalizing behavior problems, signaling the importance of self-regulation and executive function for both academic performance and classroom adjustment.

Nonsignificant correlations between AtL and the measure of cognitive flexibility at kindergarten and first grade were surprising, given that this aspect of executive

function is considered emblematic of positive AtL. It is possible that low correlations with AtL reflect issues of ecological validity with the particular measure used in the ECLS-K. The DCCS is a directly observed task requiring children to sort cards according to shifting sets of characteristics (i.e., shape or color). As such, this particular measure, while valuable for understanding children's cognitive processing capabilities, may not be tapping into the more functional aspects of cognitive flexibility relevant to AtL. To illustrate, teacher ratings of children's AtL may be focused more on the practical components of cognitive flexibility that can be observed in day-to-day classroom proceedings, such as children's ability to adapt to unfamiliar tasks or changes in routine, as opposed to their internal processing capabilities.

It is also notable that the correlation between AtL and DCCS scores became statistically significant in second grade. This shift may reflect differences in administration and scoring at this observation (recall that the second grade DCCS was administered via computer and response time was factored into the total score), or it may be an indication that cognitive flexibility becomes more relevant to AtL at later ages. Anderson (2002) has suggested that while children's control over attention begins to form in early infancy and develops rapidly in early childhood, such functions as cognitive flexibility, goal setting, and information processing develop in the middle childhood years, with a critical period between ages 7 and 9 (roughly around second grade). Further investigation of the contribution of cognitive flexibility to AtL should be explored with measures that target behavioral manifestations of the construct, such as the Heads Toes

Knees Shoulders task (McClelland et al., 2014), as well as teacher-rated or classroom observation methods, and explore the association into later grades of elementary school.

Unfortunately, ECLS-K data for kindergarten through second grade do not contain any measure of children's motivation, engagement or persistence with which to correlate AtL scores. Recall that the set of validation measures used in canonical analyses explained some 80% of the variance in AtL *SSs*, leaving a significant proportion of variance as yet unexplained. Motivational constructs may account for some of this residual variance (though they likely share significant variance with the other validation measures as well). Given the importance of early motivation for children's subsequent academic engagement and achievement, the lack of any measure of children's early motivation is a regrettable omission in the ECLS-K.

Further investigation of the ECLS-K AtL scale is warranted in key areas. Namely, examinations of the measure's performance across sex, race, and SES groups would be an important contribution to understanding the strengths (or weaknesses) of the scale given its use in such a large and diverse sample of students. Multigroup invariance and differential item functioning should be explored. Additionally, it remains unclear whether this scale is sensitive to true growth in AtL or can accurately differentiate between students with actual differences in AtL. Contrasted groups analysis, comparing mean scores for children known to have deficits in self-regulation or executive function to children without difficulties in these areas, for example, would yield useful information about the scale's sensitivity to between-child variation in AtL. IRT analyses of item difficulty and discrimination, as well as item and test information functions, would shed

light on the measure's sensitivity to differences or changes in children's overall levels of AtL.

Longitudinal Growth in AtL from Kindergarten to Grade 2

Analyses of AtL growth parameters revealed important patterns of variation in AtL in a sample representative of the population of students in kindergarten through second grade. Significant random (individual) variation was found both for initial levels of AtL at the start of kindergarten, with *SSs* ranging from 19.57 to 68.13 ($M = 50$ and $SD = 10$), as well as patterns of change over time, indicating that children's individual AtL trajectories vary significantly over the early years of school.

Latent growth models identified two subpopulations representing relatively high or low levels of AtL that remained roughly stable over time, despite minor fluctuations between fall and spring each year. These results are consistent with McDermott et al.'s (2018) examination of growth in key dimensions of the PLBS and LBS from prekindergarten to first grade. That study ascertained two classes of latent growth (high vs. low) in Competence Motivation and three classes (high, marginal, and low) in Attentional Persistence that generally correspond with the Higher and Lower AtL trajectories identified in the present analysis. Following a significant drop-off in learning behavior scores during the transition from prekindergarten to kindergarten, the trajectories depicted almost no change from fall of kindergarten to spring of first grade, similar to the growth curves discovered here. Taken together, the findings of these two studies seem to suggest that AtL is relatively stable over time from kindergarten into early elementary school.

Demographic and Parenting Correlates of AtL

The results of this investigation lend support to the notion that child and family characteristics as well as early parent involvement contribute to the development of children's early AtL. Sex, SES, family structure, and race had large, statistically significant effects on children's membership in more versus less adaptive AtL trajectories, with males, African Americans, and children from the poorest families at greater risk for poor AtL growth.

Child sex. Sex was by far the strongest predictor, with boys more than four times as likely to be classified in the lower AtL growth class as girls. This result is in line with research documenting higher rates of behavioral and learning-related difficulties among boys. Schaefer (2004) found that boys were rated as having poorer learning behaviors on 22 out of 29 LBS items in comparison to their female peers. Additionally, a number of studies have documented poorer self-regulation, executive functioning, and learning behaviors in boys compared with girls (Matthews, Ponitz, & Morrison, 2009; McCabe, Cunningham, & Brooks-Gunn, 2004; Ponitz, McClelland, Jewkes, Connor, & Farris, 2008; Ready, LoGerfo, Burkam, & Lee, 2005). It is also probable, given the very high correlation between AtL and Attentional Focusing noted here, that the overrepresentation of boys in the lower AtL growth class reflects, to some degree, their greater susceptibility to attention problems. Clinical research has documented rates of Attention Deficit Hyperactivity Disorder diagnoses from two to nine times higher among boys compared to girls (Rucklidge, 2010).

Socioeconomic status. This study both affirmed and extended the findings of research that has established significant associations between SES and children's learning behavior. Poverty, defined as income below the federal poverty line, but not low income (defined as one to two times the poverty level), measured at the start of kindergarten proved a risk factor for poor AtL growth over time. Additionally, use of public assistance conveyed significant risk for low AtL, even after accounting for the effects of poverty.

Together, these findings appear to suggest that certain contextual factors associated with poverty, as opposed to a lack of income per se, place children at a disadvantage for development of positive AtL. Research suggests, for instance, that the poorest families are particularly vulnerable to stressful life events and economic shocks, such as death or illness in the family, job loss, a or recent divorce which can negatively impact the emotional climate of the home and impair parents' ability to provide responsive and supportive care for children (Luby et al 2013; Sterling, Cowan, Weissberg, Lotyczewski, & Boike, 1985). Additionally, neighborhood disadvantage – the concentration of poverty and welfare dependency within a community – can exacerbate the impacts of stressful life events on both parents and children (Cutrona et al., 2005; Attar, Guerra, & Tolan, 1994). Such factors may stand behind observed impacts of poverty and welfare on AtL, above and beyond low income and low parent educational attainment.

Family structure. The presence of both biological parents in the home, on the other hand, provides a clear protective advantage in the development of AtL. Since this effect is also controlled for common confounders such as income and race, it seems

plausible that two-parent households differ in important qualitative aspects from single-parent homes, rather than simply offering more financial stability and resources for children's education. For instance, children in two-parent homes may benefit from longer or more frequent parent-child interactions simply because there are twice as many opportunities for such contact.

Alternatively, these effects may represent more nuanced differences in the emotional climate and organization of the home, family functioning, and/or the quality of parent-child interactions. Some research suggests that two-parent households may benefit children's development by providing more emotionally stable and predictable home environments, with greater access to the social and emotional support resources that serve to buffer the effects of poverty and stressful life events on both parents and children (Brown, 2004; Borkowski, Ramey, & Bristol-Power, 2002; Fincham & Hall, 2005; Grych, 2002; Houghughy & Long, 2004).

Race. This analysis was designed to improve upon previous studies by controlling for the confounding effects of race, poverty and parenting as they relate to observed disparities in children's developmental outcomes. For instance, Schaefer (2004) documented significantly higher odds of teacher endorsement for 12 out of 29 negative classroom behaviors among African American students compared to whites, while McDermott et al.'s (2018) findings indicated significantly lower odds for such behaviors among Hispanic students. However, these analyses were not controlled for SES variables such as parents' educational attainment or income.

In the present study, race significantly predicted AtL class membership when SES and family structure were controlled, with African American children nearly 30% more likely to be classified in the Lower AtL trajectory. This finding suggests that race may have an impact on children's developmental outcomes above and beyond the effects of SES and family structure. Additionally, the fact that the effect for race became insignificant after parenting variables were added into the regression suggests that race effects on AtL may be explained by differences in parenting practices between African American and other families.

Research supports this hypothesis. Brooks-Gunn and Markman (2005), for instance, note that "When researchers measuring school readiness gaps control for parenting differences, the racial and ethnic gaps narrow by 25–50 percent" (p. 139). It is possible that much of the variance in AtL associated with race, as observed in the current study, can be accounted for by differences between African American and non-African American families with regard to spanking practices. Research has documented more prevalent and more frequent use of spanking among African American families compared to white and other families (Berlin et al., 2009; Gershoff, Lansford, Sexton, Davis-Kean, & Sameroff, 2012; Giles-Sims, Straus, & Sugarman, 1995; MacKenzie, Nicklas, Brooks-Gunn, & Waldfogel, 2011).

Parent involvement. Only one of the several indicators of parents' support for learning at home emerged as a predictor of AtL growth in this analysis. Given the lack of a psychometrically sound composite measure of parenting, these results should be interpreted with caution. On the other hand, parent expectations and involvement with

children's schools at kindergarten demonstrated strong associations with positive AtL development, as expected. Spanking, which has been identified in the literature as a risk factor for various aspects of children's development (as discussed above), was found to significantly predict poorer AtL. It is unclear whether this finding reflects direct effects of spanking per se, or whether it might be indicative of more subtle differences in parenting between parents who spank and those who do not. Research has suggested, for instance, that parenting characterized by restrictiveness, negative affect, and harshness may stifle children's exploratory behavior in early childhood, preventing them from developing the initiative and sense of self-efficacy necessary for positive learning behavior (Larzelere et al., 2013). It is also quite possible that spanking is used more frequently with children who exhibit behavior problems, which may also be reflected in poor learning-related behaviors as rated by teachers.

Study Limitations

As with any secondary analysis, the current study is limited in some respects by the types of variables and measures available in the ECLS-K kindergarten through second grade public use data set, as well as their quality and their completeness. Other limitations relate to the complexities of the methods employed.

As previously noted, there have been no published studies verifying the factor structure of the SRS, from which the AtL scale was purportedly extracted. However, because item-level data for the other subscales of the SRS are not available in the public use data set, item-level factor analysis could not be performed here. The present study

relies on reports that developers of the scale conducted such analyses and that the AtL items factored out as a subscale (Rock & Pollack, 2002).

With regard to analyses of the concurrent validity of the ECLS-K AtL scale, it is important to note that differences in the magnitude of correlations between AtL and the individual validation measures may be explained, in part, by the type of measurement used. Measures of AtL, attention, self-regulation, social skills, and behavior problems were all collected via teacher report, whereas math and reading proficiency and cognitive flexibility were directly assessed. As such, some of the shared variance observed among teacher-rated measures is likely attributable to assessor variance (Waterman, McDermott, Fantuzzo, & Gadsden, 2012). Unfortunately, because a teacher identifier variable is not provided in the public use data file, it was not possible to estimate these effects. Nevertheless, given the strength of the associations and the logical and theoretical correspondence between AtL, self-regulation, and social skills, the finding of significant correlations between these variables is likely robust to assessor effects.

Another limitation relates to the relative certainty with which children's individual AtL growth trajectories were classified into either the Higher AtL or Lower AtL classes. Latent trajectories are maximum likelihood estimations of unobserved patterns of variation in individual slopes and intercepts. As such, there exists some level of uncertainty surrounding classification of each subject into one of the estimated classes. Entropy represents the level of certainty with which subjects have been classified according to the statistical model. When there is perfect classification (i.e., every subject is classified with 100% probability), the value of entropy is equal to one. However, as

classification probabilities for the classes become more equal (i.e., probability of being classified in one class is very similar to the probability of being classified in the other), entropy is reduced.

As reported in Table 8, entropy for all multiple-class latent growth mixture model solutions was approximately .60. Values of entropy greater than .80 are typically considered to indicate good classification (Ram & Grimm, 2009). Thus, entropy values for models presented in this study are not optimal. Classification probabilities are above .85 for both classes, which provides some support for the classification accuracy of the model. However, since lower values of entropy have been shown to overestimate regression coefficients for variables regressed onto latent classes (Heron, Croudace, Barker, & Tilling, 2015), results should be viewed as suggestive of the relative contributions of parenting and demographic factors to AtL growth trajectories, and not exact estimates of the magnitude of the relations between them.

Finally, it proved infeasible to construct a valid and reliable scale representing dimensions of parents' involvement at kindergarten. Interitem correlations for items representing parents' support for learning, discipline and routines in the home, and involvement in school were low ($r < .20$ for most variable pairs), suggesting that the items used in these sections of the ECLS-K parent questionnaires are not tapping into a common underlying construct. While this is unfortunate, it is a common occurrence in large-scale surveys, where content is often selected based on political priorities and/or the idiosyncratic interests of various stakeholders, rather than psychometric analyses. Consequently, the individual indicators of parenting used in this study may not represent

the most valid or reliable measures of parent involvement as a construct. Still, the findings of these analyses are suggestive that some aspects of parents' engagement in home-based activities with their children on a regular basis may contribute to the development of positive AtL.

Contribution and Future Directions

The findings of this study contribute substantially to the understanding of children's AtL, both in terms of construct validity and measurement per the ECLS-K scale, as well as patterns of variation within and between children in a large, nationally representative sample over the early years of schooling. However, there remains much to be done in developing a consensus within research and policy communities around the definition, dimensions, and measurement of AtL.

In particular, this study established clear links between AtL and such related constructs as self-regulation and attention. The relative predictive power of AtL when compared with these constructs remains to be seen. Existing research has established that measures of AtL predict variance in important academic outcomes above and beyond that predicted by social skills, behavior, and cognitive ability (Claessens et al., 2009; DiPerna et al., 2007; Duncan et al., 2007; Durbrow & Schaefer, 2000; Matthews et al. 2010; Schaefer & McDermott, 1999). However, it would be useful to establish whether AtL uniquely explains variance in outcomes after controlling for other measures of self-regulation and/or attention. Such evidence would clarify the relative utility of AtL compared with measures of related constructs commonly examined in education research. Additionally, it remains unclear exactly what role is played by aspects of executive

function such as memory and cognitive flexibility in defining AtL. This analysis found no significant correlation with cognitive flexibility for two of the three years for which data were available. To the extent that this scale was intended to capture some aspect of cognitive flexibility, it does not appear to do so currently, at least as the construct is measured by the DCCS.

Also, as noted above, the analysis of concurrent validity conducted here was incomplete in the sense that it was unable to examine shared variance with any measure of children's motivation or persistence. These are foundational concepts for AtL as a construct, and future research should explore associations between the ECLS-K scale and measures of these constructs. In particular, an analysis comparing scores on the ECLS-K AtL scale with scores on the LBS dimensions would be particularly informative, as it could provide some indication of construct coverage by the AtL scale.

Finally, more work is needed to understand the mechanisms by which children develop AtL and the factors that contribute to differences in AtL between individuals and groups of children as defined by race, sex, and SES. The present study hints at important differences, including specific parent behaviors as well as possible influences on the quality of the home environment and/or parent-child relationships, which appear to predispose children towards more versus less adaptive approaches to learning as early as the start of kindergarten. However, it is not exactly clear how these influences operate.

Future research should examine these relationships using psychometrically sound, multidimensional measures of parenting and home environments that have been proven appropriate for diverse samples. Total and scale scores of the Home Observation for

Measurement of the Environment (HOME) have been validated for use in a wide range of contexts and populations and have been employed in large-scale surveys including the Infant Health and Development Program (Bradley, Whiteside, Mundfrom, Casey, Caldwell, & Barrett, 1994), the National Longitudinal Study of Youth-Child Supplement (Mott, 2004), the NICHD Study of Early Child Care (NICHD Early Child Care Research Network, 2005), the Panel Study of Income Dynamics-Child Development Supplement (Mainieri, 2006), the Project on Human Development in Chicago Neighborhoods (Leventhal, Selner-O'Hagan, Brooks-Gunn, Bingenheimer, & Earls, 2004), and the Early Head Start Research and Evaluation Project (Love et al., 2002).

The Family Involvement Questionnaire, described above, is a brief parent-report measure that assesses home-based as well as school-based involvement in children's education, and has been shown to predict children's positive learning behaviors (Manz, Fantuzzo, & Power, 2004; Fantuzzo et al., 2004). Finally, the Parent Involvement in Early Learning Scale (Manz, Gernhart, Bracaliello, Pressimone, & Eisenberg, 2014) was developed to assess parent involvement as a unidimensional construct, using items very similar to those used in the ECLS-K.

Further research illuminating the parenting practices that help to foster positive AtL in young children, particularly those from the poorest families, could suggest avenues for intervention with parents and children in the critical years leading up to and including kindergarten and the early grades of elementary school that may go a long way toward narrowing racial and socioeconomic achievement gaps.

APPENDICES

APPENDIX A

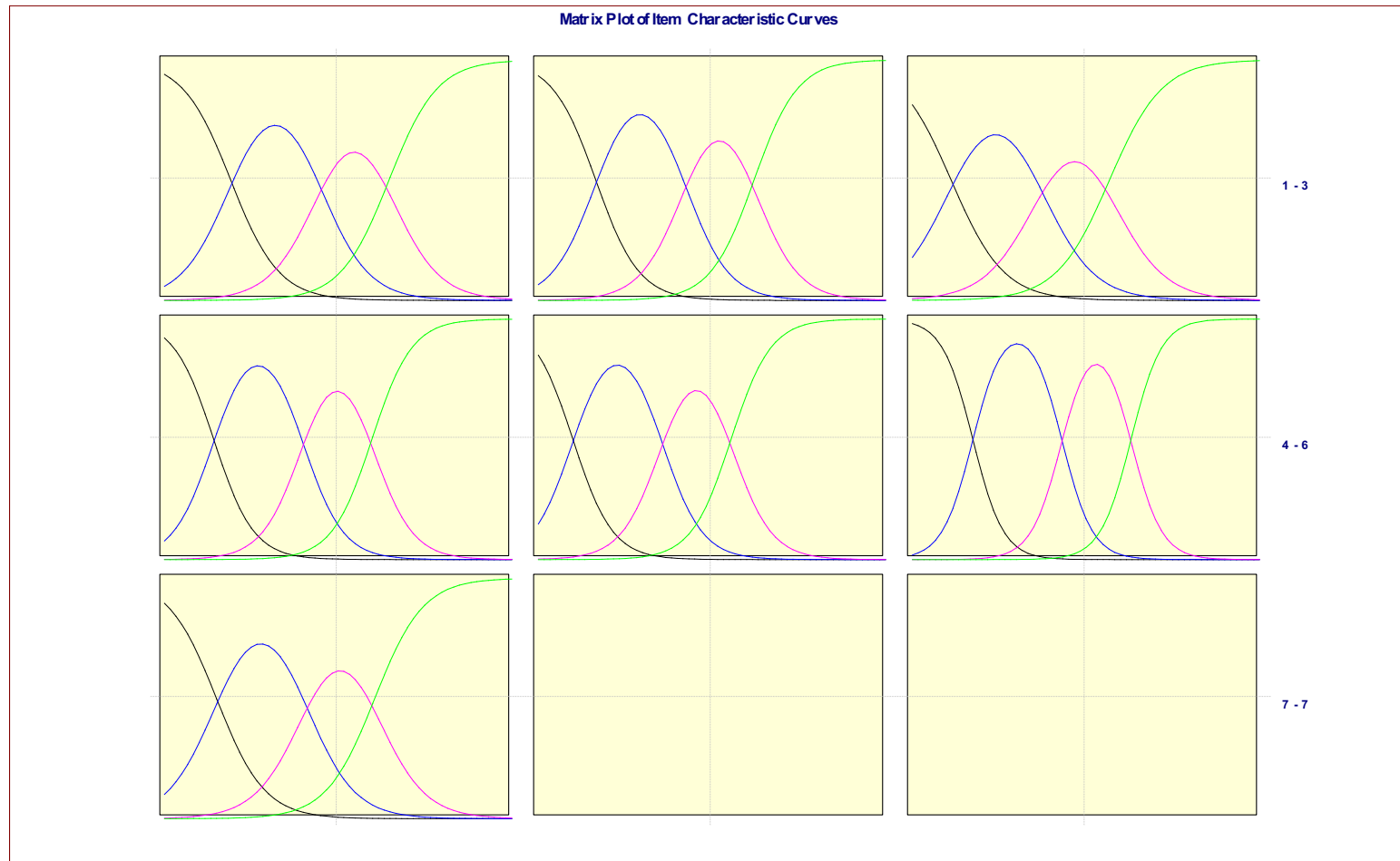


Figure A1: Item characteristic curves for ECLS-K AtL scale items

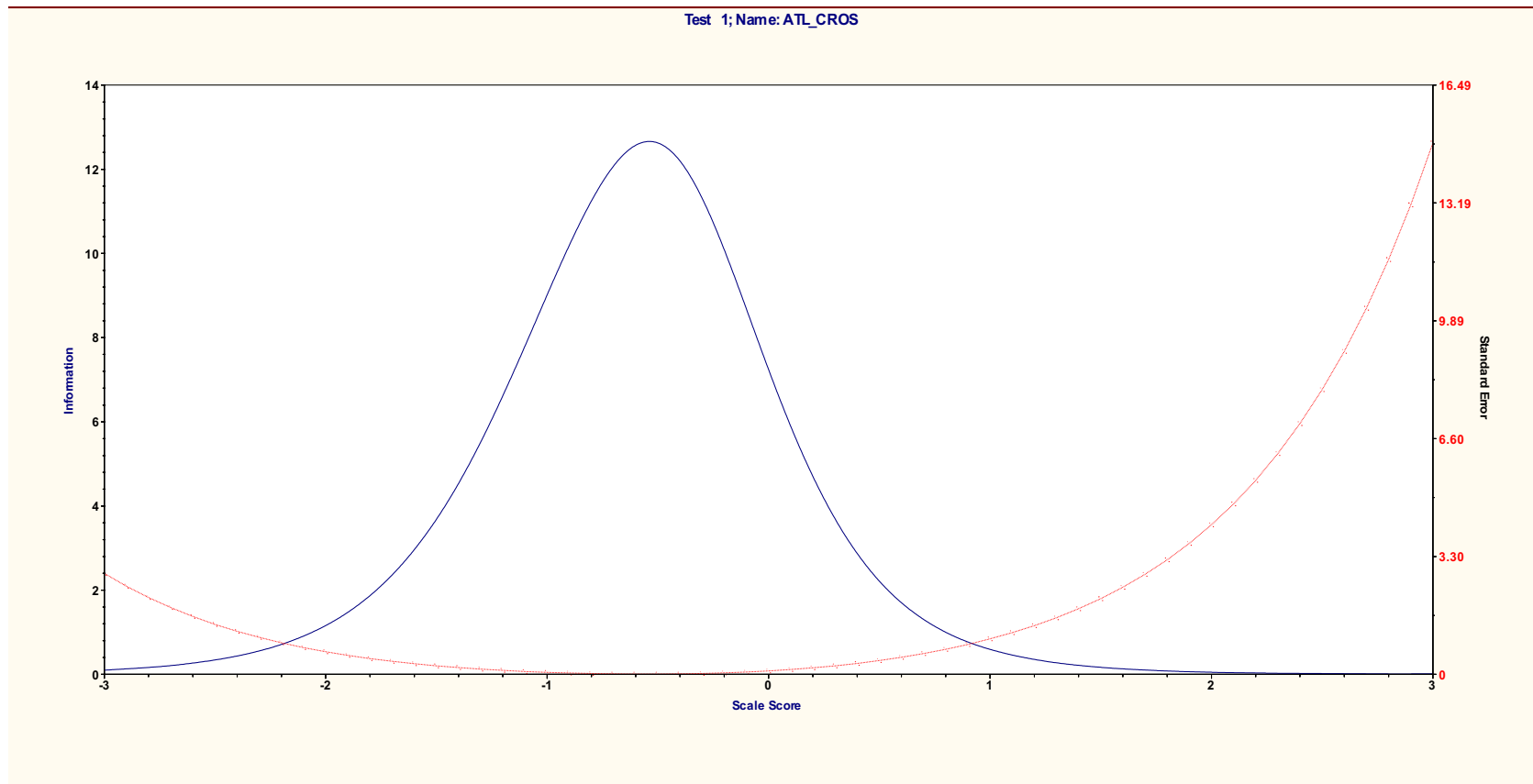


Figure A2: ECLS-K AtL scale test information function with standard error curve

APPENDIX B

Table B1: Means and Correlation Coefficients for Demographic and Parenting Correlates of AtL Latent Class Membership

Variable	<i>M</i>	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1 LatClass	.64	1.00	-.24	-.10	-.16	-.17	.15	-.06	.03	.07	.05	.06	-.08	-.03	.06	.11	.07	.14
2 Male	.53	-.24	1.00	.03	.02	.05	-.02	.22	.04	.01	-.01	.00	.05	.02	.00	-.07	.00	-.02
3 Black	.12	-.10	.03	1.00	.12	.16	-.29	.00	-.03	.01	.00	.03	.05	-.02	-.04	-.01	-.05	-.09
4 Poverty	.25	-.16	.02	.12	1.00	.60	-.27	-.02	-.04	-.09	-.14	-.09	.13	.11	-.15	-.09	-.19	-.27
5 Welfare	.25	-.17	.05	.16	.60	1.00	-.33	.02	-.01	-.05	-.10	-.01	.10	.11	-.13	-.14	-.13	-.24
6 TwoPar	.75	.15	-.02	-.29	-.27	-.33	1.00	.03	.03	.02	.06	.03	-.02	.01	.07	.13	.07	.17
7 Build	.43	-.06	.22	.00	-.02	.02	.03	1.00	.29	.22	.14	.12	.00	.06	.05	.02	.05	.07
8 Science	.32	.03	.04	-.03	-.04	-.01	.03	.29	1.00	.22	.12	.10	-.02	.03	.04	.03	.07	.10
9 Games	.65	.07	.01	.01	-.09	-.05	.02	.22	.22	1.00	.20	.18	-.03	.02	.06	.05	.08	.13
10 ReadTo	.51	.05	-.01	.00	-.14	-.10	.06	.14	.12	.20	1.00	.17	-.06	.06	.09	.07	.11	.19
11 Numbrs	.93	.06	.00	.03	-.09	-.01	.03	.12	.10	.18	.17	1.00	.00	.02	.04	.07	.09	.10
12 Spank	.24	-.08	.05	.05	.13	.10	-.02	.00	-.02	-.03	-.06	.00	1.00	.00	-.08	.01	-.01	-.06
13 Dinner	.55	-.03	.02	-.02	.11	.11	.01	.06	.03	.02	.06	.02	.00	1.00	.01	.00	.01	-.05
14 Bedtim	.91	.06	.00	-.04	-.15	-.13	.07	.05	.04	.06	.09	.04	-.08	.01	1.00	-.01	.08	.12
15 Expect	.85	.11	-.07	-.01	-.09	-.14	.13	.02	.03	.05	.07	.07	.01	.00	-.01	1.00	.06	.09
16 Event	.80	.07	.00	-.05	-.19	-.13	.07	.05	.07	.08	.11	.09	-.01	.01	.08	.06	1.00	.28
17 VolSch	.59	.14	-.02	-.09	-.27	-.24	.17	.07	.10	.13	.19	.10	-.06	-.05	.12	.09	.28	1.00

Note. $N = 2,981$, LatClass = latent class assignment where 1 = Higher AtL and 0 = Lower AtL.

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